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### TRANSACTIONS OF THE SOCIETY.

#### VII.—On the Male Genital Armature of the Dermaptera. Part I.: Protodermaptera (except Psalidæ).

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PLATES V. TO IX. AND FIGS. 55 TO 57.

THE appearance of a paper by H. W. Verhoeff in 1902, under the title "Ueber Dermapteren. I. Aufsatz. Versuch eines neuen, natürlichen Systems auf vergleichend-morphologischer Grundlage und ueber den Microthorax der Insekten," in Zool. Anzeig., did not arouse very immediate, nor wide-spread, attention among the

#### EXPLANATION OF PLATE V.

- | FIG.   | FIG.   |
|--|--|
| 1. <i>Diplatys lefroyi</i> Burr.   | 15. <i>Diplatys conradti</i> Zacher (nec Burr).<br>After Zacher. |
| 2. <i>D. gladiator</i> Burr.   | 16. <i>D. vosseleri</i> Burr. After Zacher.                      |
| 3. <i>D. bormansi</i> Burr.  | 17. <i>Nannopygia picta</i> Zacher. After<br>Zacher.             |
| 4. <i>D. liberatus</i> Burr.   | 18. <i>Karschiella camerunensis</i> Verh.<br>After Zacher.       |
| 5. <i>D. rufescens</i> Kirby.  | 19. <i>K. büttneri</i> Verh. After Zacher.                       |
| 6. <i>D. gerstæckeri</i> Dohrn.  | 20. <i>K. neavei</i> Burr.                                       |
| 7. <i>D. riggenbachii</i> Burr.  | 21. Ditto.   |
| 8. <i>D. raffrayi</i> Borm.  | 22. <i>Bormansia africana</i> Verh. After<br>Zacher.             |
| 9. <i>D. macrocephalus</i> Pal.-Beauv. (?).                                      | 23. <i>B. impressicollis</i> Verh. After<br>Zacher.              |
| 10. (?)*   | 24. <i>Pygidicrana V-nigrum</i> Serv. After<br>Zacher.           |
| 11. <i>D. conradti</i> Burr (nec Zacher).  | 25. <i>P. fiebrigi</i> Burr. After Zacher.                       |
| 12. <i>Diplatys</i> sp. n. ( <i>conradti</i> Zacher,<br>nec Burr).               |  |
| 13. <i>D. æthiops</i> Zacher (nec Burr =<br><i>conradti</i> Burr. After Zacher). |  |
| 14. <i>D. macrocephalus</i> Zacher (nec Pal.-<br>Beauv.). After Zacher.          |  |

\* I very much regret that I am unable to identify this figure: there has been a *lapsus calami* in the MS.; the original material is warehoused and inaccessible; the proofs I received travelling in Russia, and so had no means of verifying doubtful points. This must be accepted as an excuse for any inconsistencies which may have crept into the article; the figure will be identified and discussed at a suitable occasion in a later paper.—M. B.

limited number of entomologists who took any interest in the question of the classification of the Dermaptera. The reason is not far to seek: the entire absence of figures, the employment of a number of new characters under new and unfamiliar names, which are nowhere explained, the author's ignorance of the literature of the subject, and the rather obscure language which he employed, together with the fact that he rendered untenable the old make-shift system, which was only accepted by serious students as a temporary convenience, but failed to set up a new one in its place.

The consequence is that most students of the Dermaptera treated Verhoeff's work with a neglect that it did not deserve, entirely through inability to understand it. I was myself profoundly discouraged when I found that he had erected a new genus, *Nesogastrella*, the only character of which was the pin-hole through the elytra! I saw his type afterwards in Berlin; it had been carded, but the big hole made by a common pin was very evident. The specimen was nothing more nor less than a female of the very common *Nesogaster amicus* Stål. Such errors, and the blunder in the use of the name *Gonolabis*, "Burr et mihi," which I have exposed elsewhere, led one to suppose that the whole work was of the same quality, and by common accord Verhoeff was quietly neglected.

But the virtue in his work was at length proclaimed by his keen countryman, Dr. Friedrich Zacher. Thanks to the free access to Verhoeff's types and microscope slides, which were often in very poor condition, Zacher was able to understand what Verhoeff meant, so that he realized the great importance of his compatriot's work; at the same time, being a modern recruit to the subject himself, he was not so likely to have his vision biased by the *Nesogastrella* and *Gonolabis* blunders. Zacher quite justifiably calls Verhoeff's work "bahnbrechend"; it has broken new ground, and pointed out the new method.

Verhoeff's work suffered from being premature, for the amount of material available was then small. In 1911 Zacher brought out the next step, "Studien über das System der Protodermapteren," \* a very important paper, explaining Verhoeff's work, carrying it a good step farther, and above all illustrating it with a large number of figures. Zacher's work has a double virtue; it not only has its own inherent goodness—that is, the actual original observations—but it is a key to Verhoeff, rendering his crabbed words intelligible.

For want of material Zacher was unable to do more than sketch out a system in parts; he has since supplemented the original paper, and Borelli has added descriptions of the genitalia

\* Zool. Jahrb., xxx. Heft 4 (1911).

in a few Neotropical forms. But nothing in a comprehensive way has been done since the appearance of Zacher's work.

Although we differed on a number of points of detail, Zacher and I soon found that, though travelling by different roads, we were converging towards a common result. I had previously confined my attention to purely external morphological characters, but now set to work to make a comparative examination of the male genital armature of as great a variety of species, and of genera, as possible.

I am consequently able to supplement Zacher's work very largely, and to confirm or modify his opinions. The accumulation of a much richer material than either Verhoeff or Zacher ever had at their disposal, the preparation, study, illustration, and comparison, has taken a great deal of time, and as in the future I dare not hope to have much time at my disposal, I venture to publish these notes, incomplete as they are, in the hope that they will stimulate other workers to enter the field, and carry on the progress. The classification of the *Psalinæ* in particular requires much study.

It is with the object of drawing the genitalia that I have in recent years impressed on my correspondents abroad the desirability of preserving and packing their specimens in spirit; it is very important that spirit specimens should be kept in as great variety as possible, for we are yet very far from the ideal of possessing a good and careful drawing and description of the genital armature of every known species of earwig.

I am very much indebted to Lt.-Col. F. W. Winn Sampson for the preparation of the slides, work which demands both skill and time, neither of which I was in a position to employ myself. From these slides I have made the drawings which illustrate this paper; they are I fear, very amateurish, and not uniform, but they have the advantage of throwing into relief the points which I wish to emphasize. There is great scope for investigation in the structure of some of these complex organs; I have begun, and hope one day to be allowed to finish, a series of observations on the genitalia of *Diplatys* under very great magnification, with the help and advice of a trained histologist. But for the ordinary purposes of the systematist, an ordinary microscope with 1-in. objective for general examination, and  $\frac{1}{4}$ -in for details, is quite sufficient.

There is no difficulty in drawing out the genitals from a fresh or spirit-preserved earwig; if the large ninth sternite, or penultimate ventral segment, be lifted, the parameres may be seen resting in a little hollow, from which they may be drawn out with a fine pair of forceps, and transferred to a small tube to await their turn for staining, or they may be simply mounted at once in balsam.

But in dealing with old and dried specimens, the difficulty is greater. I find the simplest method is to break off the last two or three segments of the abdomen, preferably only the last two; this

can easily be done, though it takes a certain knack to break off only the required parts, which is desirable, as if other segments

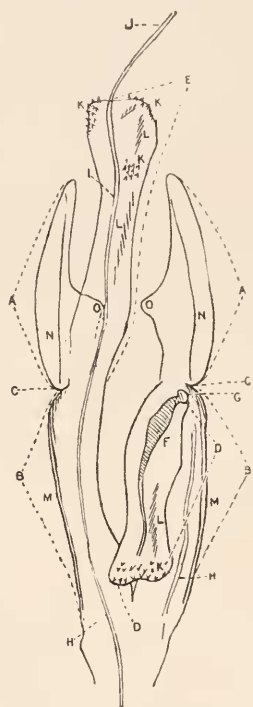


FIG. 55.—PROTODERMAPTEROUS TYPE.

- A. Metaparameres.
- B. Proparameres.
- C. Hinge.
- D. Præputial sac in repose.
- E. Ditto, in erection.
- F. Virga, with spiral structure (Allostethine type.)
- G. Basal vesicle of virga (Echinosomatine type).
- H. Ejaculatory ducts (indistinct).
- I. Simple form of virga.
- J. Projecting whip-like end of virga in erection.
- K. Pads of denticulations.
- L. Chitinous thickenings.
- M. Strongly chititized external margin of proparameres.
- N. Midrib of metaparameres (Psalid type).
- O. Internal tooth of metaparameres.

come off, the repairing is extremely difficult. The detached portion should then be boiled gently in caustic potash, the genitals withdrawn and washed, and the two segments placed back in position and cemented. It is well to label such an individual, as if the repairing is well done, one may attempt to repeat the process at a later date upon an already castrated specimen. These old specimens are never so satisfactory as fresh or as spirit-preserved ones, since the delicate structures within the præputial sacs are always obscured; but at all events, the outlines of the metaparameres can be seen clearly, and this is a very important point.

The male reproductive apparatus of earwigs consists of a pair of chitinous segments, the parameres, which are attached to a fibrous muscular base, the first segment, or proparameres, usually simple long and narrow plates, strongly chititized in the external margin only; the apical segments or metaparameres offer an extraordinary diversity of size and shape, and are of great systematic value. Sometimes there is a small accessory lobe, or epimerit, at the apex of the metaparameres.

The metaparameres are attached by a distinct hinge to the parameres in most Protodermaptera, but are almost fused into one in the *Echinosomatinae* and in the Eudermaptera, where the

proparameres are degenerate. The former act as grips, for locking the organs to the female *in copula*. Attached to the parameres



are the præputial sacs, or penis proper. There are a pair of these in the Protodermaptera, though one is aborted in the *Hemimerina*, *Arixenia* and *Karschiellina*, but only one in the higher Endermaptera. Within the præputial sacs is a tube called the virga, a portion of the ejaculatory duct, which also offers a great diversity of form and affords highly valuable characters. The virga may be a simple tube, a mere extension of the ejaculatory duct; in many groups it is protected, especially near the base, by a fine spiral binding, the "spiralversteifung" of Zacher, which is especially noticeable in the inflated basal vesicle seen in many groups. In the *Labidurina*, the virga is undulated and serpentine; the length of the virga and form and armature of the basal vesicle offers useful specific characters, especially in the *Forficulidæ*. The præputial sac is frequently furnished with chitinous plates or disks, and sometimes with a series of minute teeth. In order to detect the latter, and generally to examine the virga, it is necessary to use a high power of magnification, and often a careful manipulation of light, as the virga and the armature of the præputial sacs are often faint and difficult to extinguish.

While, I think, everyone will agree that Zacher overrated the value of the genitalia, yet they undoubtedly afford extremely useful generic and specific characters. In the lower earwigs we find a considerable complexity of armature, the genitalia becoming simpler and simpler till we meet a general uniformity in the highest groups.

Probably their study will enable us to define species in such a group as the *Echinosomatina*, where mere differences of colour are still used as specific characters; and in the *Psalida*, where there is a great uniformity of external features; the study of these organs may enable us to demarcate the genera.

As far as we can yet see, it looks as though the genera based upon these characters may coincide with geographical groups. In the *Pygidieranida*, we find the Ethiopian genus *Dicrana* sharply distinguished by the structure of the genitalia from its Neotropical, Oriental, and Australian relatives—that is to say, the type of

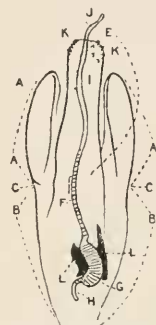


FIG. 56.—EUDERMAPTEROUS TYPE.

- A. Metaparameres.
- B. Proparameres. C. Hinge.
- E. Præputial sac in erection.
- F. Virga (with spiral structure).
- G. Reniform or basal vesicle of virga.
- H. Ejaculatory duct.
- I. Simple virga.
- J. Protruded end of virga.
- K. Denticulations.
- L. Chitinous armature of basal or reniform vesicle.

metaparameres characteristic of *Dicrana*, and no other genus, occurs only in Africa.

Without any desire to underrate the great value of his work, I certainly think that Zacher overrates the importance of the armature of the præputial sac, and I feel quite unable to grant generic value to the rows of teeth, often very difficult to observe, and so perhaps sometimes overlooked, and chitin pads and plates in the præputial sac. I also consider the virga to afford specific rather than generic characters, for we find great diversity in the length of this organ in species that are undoubtedly closely related, and, in my opinion, congeneric.

In dealing with old and dry specimens, the virga is often difficult or impossible to distinguish; it may be shrivelled away, or dissolved out by the action of the potash. I certainly think that no definite negative opinion on the virga should be formed till several specimens have been examined, as its visibility differs very much in different mounts.

I consider that the most important family characters are afforded by the metaparameres; here we find a grouping into kindred forms that often corresponds well enough with the geographical distribution. But these are after all only secondary sexual characters, analogous to the forceps; and just as we find considerable plasticity in the latter, so we must not be surprised if we find it also in the former. I think we are in the presence of dimorphism in the cases of *Euborellia sisera* Burr and *E. greeni* (see Part II.), where two individuals, externally indistinguishable, often have quite difficult metaparameres.

I am not alone in my opinion that Zacher overrates the value of the genital armature for generic characters. It is no breach of confidence to quote the words of so eminent an entomologist as my old friend Dr. H. A. Krauss: "Ich freue mich, dass Sie trotz Verhoeff & Zacher bei der Benützung der äusseren Kennzeichen für die Systematik geblieben sind & die Spitzfindigkeit der männlichen Copulationsorgane erst in's Hintertreffen gestellt haben. Schliesslich hätte man nur noch mit Virga, Praeputialsack & Parameren gearbeitet & das Wichtigste, das Äussere der Tiere, wäre vernachlässigt worden. Und in den Sammlungen wären nur noch Rudimente der Tiere mit abgeschnittener Abdomenspitze zurückgeblieben"; also the distinguished Dermapterist Dr. A. Borelli, who writes me: "Credo come Lei che non bisogna fare troppi generi basandosi unicamente sulla forma dei parameri o sulla presenza di denti, strie o altri ornamente, d'altronde gli apparati genitali non sono che uno dei caratteri, bisogna tenere anche conto degli altri."

The true earwigs fall into two groups, those with a pair of penes, the Protodermaptera, and those with one, the Eudermaptera. In the former group, each præputial sac takes its origin from the

apex of the proparameres, is directed backwards in repose, so that the ejaculatory duct is doubled back upon itself; but in erection the præputial sacs are directed forward, so that the ejaculatory ducts are straightened. But in the Endermaptera there is no discernible trace of the lost penis, and the remaining præputial sac is not reversed, but directed in repose as in erection, the protrusion being the only difference in the latter condition, consequently the ejaculatory duct is never bent; the præputial sac here seems to take its origin from the basal part of the weakened proparameres.

When we remember this, it is surprising to find that in *Hemimerus* and *Arixenia*, which are looked upon as primitive forms, one penis is rudimentary. In the former we have what is really a Endermapterous form of penis, with single direct præputial sac and ejaculatory duct.

In *Arixenia* the rudiments of the abortive præputial sac and ejaculatory duct are discernible, and the functional sac is direct, as in the Endermaptera, and not reversed in repose, as in the Protodermaptera. We find a somewhat, but not quite similar arrangement in the *Karschiellinæ*, as shown by Zacher, but the degeneration of the second penis is less accentuated than in *Arixenia*, the rudimentary præputial sac being discernible.

It is surprising to find in these apparently primitive groups features in the reproductive organs, and also in the opisthomeres which are associated in the so-called higher section of the earwigs. Either the *Arixenia* and *Hemimerina* are less primitive than usually considered, or we must modify the opinion which I have expressed, that the progressive degeneration of the opisthomeres is a good measure of the higher development in the Dermaptera.

The fact that in such primitive groups as the *Arixenina* and *Hemimerina*, and in the *Karschiellinæ*, one of the lowest of the *Protodermaptera*, the genitalia approach the form which generally characterises the *Endermaptera*, or higher earwigs, compels us to believe that the reduction of one penis is not necessarily evidence of a higher stage of development, and to my mind robs the male reproductive system of much of the value that has been attached to it as evidence of the phylogenetic relationship of the various sub-divisions of the Dermaptera.

I am now prepared to modify the arrangement proposed in the *Genera Insectorum* (1911). I propose to sink the *Paradermaptera*, reducing them to family rank, within the *Protodermaptera*. The strongly flattened body is not enough to warrant the separation of the *Paradermaptera*, since, if it were, we should be obliged to raise the rank of the *Platylabiinæ* and of the *Sparattinæ*; neither has the squamopygidium, since an apparently identical structure is admittedly only given generic value in the case of *Gonolabina*.

The other chief alteration is the transference of the *Allostethinæ* from the *Labiduridæ* to the *Pygidieranidæ*, on the strength of the

presence of two pairs of gonapophyses in the female. I do this with some hesitation, but the presence of gonapophyses is certainly a primitive feature; after all, it is really only a matter of convenience in which group it is placed, for it has very sharply marked characters of its own.

I have also felt obliged to separate *Psalis femoralis* into a distinct genus and sub-family, for reasons which will appear later.

### SUB-ORDER I.—**ARIXENINA.**

The reproductive apparatus is described in detail by Jordan and Burr in both sexes. The male organ is complicated, and differs from that of the true earwigs in having the form of a tube or cylinder, instead of being dorso-ventrally flattened. One ejaculatory is rudimentary, persisting as a blind branch on the functional duct, which runs from the seminal vesicle where the vasa deferentia meet, into the vesicle at the base of the penis, corresponding to the basal vesicle in the true earwigs. The rudimentary duct is thrown off just above this vesicle. The duct continues through the single præputial sac, corresponding to the virga, which is long and coiled.

Jordan detected a funnel-shaped cavity on the ventral side, receiving a thin tube which runs the whole length of the organ. This is probably the rudiment of the second præputial sac with its virga. This rudimentary penis is unarmed, but the functional penis has a complex chitinous armature recalling that of many *Labiidæ*. There are four irregularly shaped chitinous bars or plates; the virga is continued in a chitinous tube that joins this armature, though the duct itself does not. The proparameres are very weak and feebly chitinized; the metaparameres scarcely stronger; these are sub-cylindrical, finger-shaped, feebly chitinized and studded with sensory papillæ-like setæ. They are manipulated by a pair of strongly chitinized rods or levers, which extend

### EXPLANATION OF PLATE VI.

FIG.

1. *Dicrana wigginsi* Burr.
2. *D. bettoni* Kirby.
3. *D. biafra* Borm.
4. *D. caffra* Dohrn. After Zacher.
5. *D. elongata* Zacher. After Zacher.
6. *D. phoenix* Zacher. After Zacher.
7. *Picrania liturata* Zacher (nec Stål).  
After Zacher.

FIG.

8. *Acnodes wellmanni* Burr.
9. *Tagalina semperi* Dohrn.
10. *Kalocrania similis* Zacher. After  
Zacher. [Zacher.
11. *K. marmoricrura* Serv. After
12. *K. piepersi* Burr. After Zacher.
13. *Cranapygia kallipyga* Dohrn.
14. *C. dæmeli* Dohrn.







through the proparameres, at least as far as the seminal vesicle: perhaps it would be correct to call these rods the true proparameres, for they act as supports and levers of the metaparameres. In the true earwigs we see an analogous arrangement, but it is always the outer margin of the proparameres that is chitinized, the inner margin being tender and membranous, exactly the converse of the case in *Arizenia*.

In erection the præputial sac is reversed, as in the Protodermaptera, and protruded far beyond the parameres, and ventrally to them, the chitinous armature being very prominent, the virga, or whip-like end of the ejaculatory duct, extending well beyond the tip of the longest chitin-plate.

Some light is thrown on the function of these plates by the figures of the organs in copula in Jordan and Burr. The furthest plate lies within a slit between the two halves of the eighth sternite of the female, and its hook catches the concave end of the clutch or chitinized knob of the female, another fits on to the apical margin of the left eighth sternite, another prevents the first from slipping off the clutch; they are in fact the apparatus by which the male grips and holds the female. The metaparameres do not seem to be used for this purpose at all, but to act rather as feelers than as claspers. In the true earwigs, the metaparameres are hard and horny, though usually softer and thinner on the inner margin, and are probably true claspers. When the chitin-plates occur in the true earwigs, they have some such function of grasping; anyhow, they give rigidity to the soft material of the præputial sac. This is noticeable in the figure.

## SUB-ORDER II.—HEMIMERINA.

Jordan has discussed and figured the reproductive organs in *Hemimerus*. As Verhoeff insists, it is essentially of Forficuline type. The parameres are well developed; the metaparameres are long, rather dilated about the middle, tapering towards the apex, where they are recurved into a sharp but simple, slender hook, the curvature being stronger in one than in the other. There is a single ejaculatory duct, though Jordan states that "it seems to divide where it enters the outer half of the organ of copulation; but I am not sure on that point." Probably the second duct is rudimentary, as there is a single præputial sac which is densely denticulate.

The form of the metaparameres recalls that of *Acrania horsfieldi*, but this can only be a coincidence.

SUB-ORDER III.—**FORFICULINA.**

This sub-order contains the vast majority of the Dermaptera, that is to say, the true earwigs. They fall into two super-families, one in which the male has two complete penes, the other in which there is only one.

## TABLE OF SUPER-FAMILIES.

- |   |                     |
|---|---------------------|
| 1. Apparatus genitalis ♂ duplex, penibus 2 instructus; (apud <i>Karschiellinas</i> penis unus abortivus); penes ab apice proparamerum orientes, quum haud erecti, abdomen versus directi; proparameres fortes, chitonisi, cardine distincto (subfamilia <i>Echinosomatinarum</i> excepta, cardine debili); (pygidium ♂ simplex, telson interdum adest; opisthomeres interdum in squamopygidium haud segmentatum fusi) . . . . . | 1. PROTODERMAPTERA. |
| 1, 1. Apparatus genitalis ♂ simplex, pene unico instructus, a basi proparamerum orienti, semper apicem versus directo; proparameres vix chitinosi, cardine rudimentario; (pygidium ♂ sæpius spinis armatum; telson abest, vel rudimentarius; opisthomeres semper separati) . . . . .  | 2. EUDERMAPTERA.    |

SUPER-FAMILY I.—*PROTODERMAPTERA.*

The proparameres are distinctly separated from the metaparameres by a well-marked hinge, except in the *Echinosomatinae*; they are chitinized through their length down the external margin, and fork distinctly from their base. The metaparameres offer a remarkable diversity of size and form, affording very valuable characters. Attached to the apex of the proparameres are the præputial sacs, or penes proper, which in the position of rest lie pointed backwards, towards the base of the segment; in erection they are protruded forwards, and capable of very considerable expansion; in each sac there is a tube called the virga, an extension of the ejaculatory duct, which offers useful characters, especially of specific value. In the *Diplatyginæ* they are horseshoe-shaped, and each virga has two vents; in many *Anisolabinæ* the virga is absent. In the *Labidurinae* and kindred subfamilies, the virga is inflated at the base into a reniform vesicle, of delicate texture, showing under high magnification a spiral structure recalling that of the tracheæ; in the *Labidurinae* the virga has the form of a serpentine tube inside a transparent and parallel-sided sheath.

The *Protodermaptera* fall into two groups, the *Pygidicraniales* and *Labiduriales* of Zacher, which I prefer to accept as *Pygidicranidæ* and *Labiduridæ*; they are perfectly distinct, yet it is extremely difficult to tabulate the distinctions. Zacher bluntly shirks the difficulty, saying that the groups are too hypothetical and have too few concrete characters. Unfortunately, none of the best characters lend themselves to sharply defining the two groups; if we take the presence of gonapophyses in the female, we are obliged to separate the *Pyragrinæ* from their undoubted allies, the *Pygidicraninæ*, and if we take the reduction of the telson, we are similarly obliged to remove the distinctly Pygidicranine *Echinosomatinae* into the *Labiduridæ*. The manubrium also fails to help us. In a general way, the head is flatter in the *Pygidicranidæ*, and the femora are usually keeled and compressed. In the *Labiduridæ* the parameres are generally simpler, and the virga tends to have the fine spiral structure referred to by Zacher as "Spiralversteifung," and to have an inflated reniform vesicle at the base. In the following table I have not ventured to dogmatize on the homologies of the opisthomeres in the *Labiduridæ*, and have left open the question whether the large pygidium of *Labidura* contains the metapygidium combined with it.

We are, in fact, reduced to the inconvenient necessity of making a lengthy explanation. If the female has gonapophyses, it certainly is Pygidicranine, but all Pygidicranines have not gonapophyses, e.g. the *Pyragrinæ*; we know at least that if we find gonapophyses, there is no question of a Labidurid. Again, if all these segments of the opisthomeres are present and separate, and the telson distinct and chitinous, we know we have to do with a Pygidicranid; one of these two tests applied separately, and often both simultaneously, will enable us to discriminate the two families.

#### TABLE OF FAMILIES.

- |  |                   |
|--|-------------------|
| 1. Gonapophyses ♀ adsunt; aut, opisthomerum 3 segmenta separata, telson perfectum . . . . .  | 1. PYGIDICRANIDÆ. |
| 1, 1. Gonapophyses ♀ desunt; opisthomerum sæpius segmenta tantum 2 adsunt; (interdum telson (?) rudimentarium, membranaceum, adest.) . . . . . | 2. LABIDURIDÆ.    |

#### FAMILY PYGIDICRANIDÆ.

Zacher deals with the group in considerable detail, but omits to characterize it, and to discriminate it from the *Labiduridæ*. Verhoeff defines it in a restricted sense by the development of the opisthomeres.

If we limit it to those groups in which the telson is free, we

exclude the *Echinosomatinae*, and perhaps also the *Pyragrinae*, which have Pygidicranine affinities; on the other hand, if we define it by the presence of gonapophyses in the female, we bring in the *Allostethinae*. Unfortunately, the latter organs have not been examined in the *Diplatyinae*, *Karschiellinae*, and *Pyragrinae*. The *Karschiellinae* are a very primitive group, having segmented caudal setae in the larval instars like the *Diplatyinae*, and probably gonapophyses are present in the females of both. Fortunately there is no difficulty in discriminating these groups, all of which are well characterized by other features. It therefore becomes a merely academical question whether we shall include in the *Pygidicraninae* those groups in which the female has gonapophyses but reduced telson. As a matter of pure convenience, therefore, I prefer to define the *Pygidicraninae* as that group in which either the telson is free, or, alternately, in which the female has gonapophyses; in some cases, both features may be present simultaneously. This, I admit, is presuming for the moment the presence of gonapophyses in the female of the *Pyragrinae*, *Karschiellinae*, and *Blandicinae*, which remains to be demonstrated.

The original feature of this arrangement is the inclusion of the *Allostethinae* on the strength of the presence of gonapophyses of the female, which has not previously been recorded.

#### TABLE OF SUB-FAMILIES.

1. Femora compressa ac carinulata (gonapophyses  
? adsunt).
2. Antennae setaceae, segmentis 15-25, quinto  
elongato.
  3. Corpus apterum; metanotum larvale;  
metasternum postice truncatum;  
cerci larvarum haud segmentati;  
virga simplex; oculi parvi . . . 1. ANATÆLINÆ.
  - 3, 3. Corpus alatum; metanotum haud  
larvale; metasternum postice con-  
cavum; cerci larvarum segmentati;  
virga bifurcata; oculi magni . . . 2. DIPLATYINÆ.
- 2, 2. Antennae 25-33 segmentatae, quinto et sexto  
brevibus.
  3. 1 penis abortivus; antennae crassae,  
segmentis 4, 5, et 6 transversis;  
cerci larvarum segmentati; (genera  
ethiopica) . . . . . 3. KARSCHIELLINÆ.
  - 3, 3. Ambo penes perfecti; antennae  
setaceae, segmentis 4, 5, et 6 bre-  
vibus, sed haud transversis; cerci  
larvarum haud segmentati . . . . . 4. PYGIDICRANINÆ.



- 1, 1. Femora nec carinulata nec compressa.
2. Gonapophyses ♀ adsunt; metaparameres angusti.
3. Pro- ac mesosterna postice haud angustata; tarsorum segmentum secundum haud lobatum; manubrium rotundatum; corpus valde pilosum; cardo paramerum debilis; genus palæotropicale . . . . . 5. ECHINOSOMATINÆ.
- 3, 3. Pro- ac mesosterna postice acuminata; tarsorum segmentum secundum lobatum; manubrium apice angustatum; corpus haud valde pilosum; cardo paramerum fortis; genera indomalayana . . . . . 6. ALLOSTETHINÆ.
- 2, 2. Gonapophyses ♀ desunt (?).
3. Antennæ 25-35 segmentatæ; prosternum antice acutum; genus neotropicale . . . . . 7. PYRAGRINÆ.
- 3, 3. Antennæ 25 segmentatæ; prosternum antice rotundatum; genus capense . . . . . 8. BLANDICINÆ.

### Sub-family 1. ANATÆLINÆ.

I have a single mount, unfortunately somewhat damaged, of the genitalia of the rare and curious species *Anatælia canariensis*.

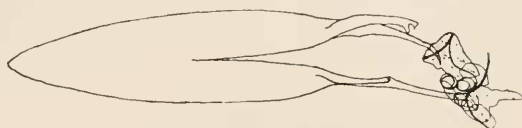


FIG. 57.—*Anatælia canariensis* Bol.

The metaparameres are much shorter than the proparameres, slender and gently curved, the tips turned in and bilobed; in the preputial sac are to be seen what appears to be the endless coils of a long virga, with chitinous indurations.

### Sub-family 2. DIPLATYINÆ.

Very marked characters are afforded by the genital armature in this group. Zacher only knew a few species, and so his proposed arrangement is extremely incomplete. The examination of a number of additional species has shown that there is a great diversity of structure in the genitalia of the *Diplatyinæ*, but it is yet premature to base the classification of the sub-family upon these characters. I have therefore refrained from erecting a host of new genera for every shape of penis and virga, and have retained

my original arrangement, provisionally, and confine myself to some observations on the genitalia of the group.

The virga possesses one very well-marked peculiarity; it is invariably horseshoe-shaped, and, as there are a pair of them, there are four orifices for the emission of the semen. In all known *Diplatynæ* this is the case, though the shape of the virga is various, and the metaparameres offer considerable diversity.

Zacher's arrangement of this genus has the merits of boldness and originality, but I am convinced that he has in some cases failed to identify his species correctly. This is a very pardonable mistake in this genus, where I often have considerable doubt in identifying individuals of species of my own description.

*Diplatys macrocephalus* Beauv.

This has always been regarded as a purely West African species, but I cannot distinguish, by external characters, a fresh specimen from Uganda, sent to me by Mr. Gowdey (Pl. V. fig. 9). The metaparameres are quite peculiar, being very strongly bowed, with the apex produced into a sharp point. The virga is short, and there is a denticulate pad.

It is important to examine the parameres of West African specimens to settle this question of identity, for the genitalia figured by Zacher and attributed to this species are totally different. Zacher's specimens are from Usambara, and he relies upon the unreliable determination of Verhoeff. It remains to be seen to what species these figures should be attributed (Pl. V. fig. 14).

*Diplatys conradti* Burr.

My original type is in poor condition, and the genitalia are inaccessible, but I have examined these organs in a specimen, also from the Kamerun, which I attribute hereto, and I find the genital figured by Zacher as those of *D. æthiops* (Pl. V. fig. 11).

The *D. conradti* of Zacher is another species. I cannot admit Zacher's sub-genus *Verhaffiella*, based on the length of the virga, as we find this organ nearly as long in some Indian species closely allied to forms with short virga. It is, in fact, only a specific character.

*Diplatys riggenbachii* Burr, and *D. raffrayi* Borm.

Here the metaparameres are slender, and of a peculiar shape; the virga is short (Pl. V. figs. 7 and 8).

*Diplatys* sp. n.

A very characteristic form of genitalia is seen in a species not yet described, from Sappo, Kamerun, in the Berlin Museum. It is

the same as that figured by Zacher under the name *D. conradti*. The metaparameres are unusually broad at the base, rapidly narrowing to a finger-like point, with an acute epimerit (Pl. V. figs. 12 and 15). The virga is short and hard, and on one side of my specimen has assumed a position out of the plane of the mount, and so cannot be seen clearly, but it is clear on the other side; it is strong and black, each branch inflated before the tip. In the præputial sac around the virga is a chitinous fibrous structure. The whole form of the genitalia agrees well with Zacher's figure except that of the virga, which is difficult to see, and Zacher expressly states that his specimen, prepared by Verhoeff, is very obscure.

The peculiar virga, digitate metaparameres, and the presence of the epimerit justify Zacher in the erection of the sub-genus *Paradiplatys* for it.

The genus *Diplatys*, as restricted by Zacher, is probably to be confined to those forms having narrow, acuminate metaparameres, with an inner tooth, and the virga with an inflation at the base, and the branches short; such are *D. macrocephalus* Beauv.,\* *D. raffrayi* Borm., and *D. riggenbachii* Burr, all Ethiopian species. In the Indian *D. lefroyi* Burr, which resembles the above African species in the inflated last abdominal segment of the male, and basally dilated, arcuate forceps, we have a similar general form, but the branches of the virga are extremely long; the genital armature of the Indian, *D. rufescens* Kirby, is very similar, with long virga, but there is no basal inflation; also, the Indian *D. gladiator* Burr has a long virga, and not very dissimilar metaparameres, and the virga has apparently a pair of basal dilations.

Zacher makes a separate sub-genus for the Ethiopian species, which he identifies as *D. æthiops* Burr, but which I consider *D. conradti*, where the virga is very long, and not inflated at the base. But as the general form of the metaparameres is the same, and the very long virga is found equally in Indian and African species, as also the basal dilation, I suppress Zacher's proposed sub-genus *Verhoeffiella*, as, if we accept it, we are obliged to erect a whole batch of fresh genera or sub-genera.

We may group those species with narrow, toothed, acuminate metaparameres, as follows:—

Virga long.	Virga short.	
..	<i>Macrocephalus</i>	. African.
..	<i>Riggenbachii</i>	. African.
..	<i>Raffrayi</i>	. African.
<i>Lefroyi</i> .	<i>Liberatus</i>	. Indian.
<i>Gladiator</i> .	<i>Gerstæckeri</i>	. Indian.
<i>Rufescens</i> .	<i>Bormansi</i>	. Indian.

\* Cf. Zacher, 1911, figs. D<sup>1</sup> and E<sup>1</sup>.

Of these, the virga has a basal inflation in *D. macrocephalus*, *D. riggenbachi*, *D. raffrayi*, *D. gladiator*, and *D. lefroyi*.

As specific peculiarities, we note the strong denticulation of the præputial sac in *D. macrocephalus*, its slight denticulation in *D. gladiator* and *D. liberatus*. The plates show the specific differences in the form of the metaparameres; the presence of a second smaller tooth should be noted in *D. liberatus*, and the form of these parts in *D. bormansi* is quite characteristic.

As to the genus *Nannopygia* Dohrn I feel sure that we are in the presence of another of Verhoeff's mistakes, which has misled Zacher. I am convinced as to the identity of my Cingalese specimens with *N. gerstaeckeri* of Dohrn, and my figure shows as quite typical Diplatyne armature, whereas Zacher states that Verhoeff's specimen, with no indication of locality, has bifid metaparameres, and places it with his *N. picta* from British East Africa. It is very easy to make a mistake of identity in this group, and Verhoeff may have had *D. ernesti* Burr, or *D. jacobsoni* Burr, before him, in neither of which are the genitalia yet known. Anyhow, the genitalia of my *D. gerstaeckeri* are not, in my opinion, generically different from those of the other species considered, and I maintain my long-stated opinion, that *Nannopygia* cannot be generically separated from *Diplatys*. If it ever is, it will be upon the form of the ninth sternite and forceps.

Zacher's *N. picta* has a peculiar form of metaparamere which would better justify a new genus than the virga, and approaches the form seen in his figure of *D. vosseleri* Burr. In both the metaparameres are broad and bifid, and on this I should be willing to grant them generic rank; in both there is a denticulate area in the præputial sac. In *D. vosseleri* the virga is basally inflated, and in *D. picta* it is decidedly longer. This is further evidence in favour of my contention that the virga offers characters rather of specific than of generic value.

I should have felt inclined to give generic value to the form of the forceps and last abdominal segment, but for the fact that *D. raffrayi* differs in this respect from *D. macrocephalus*, yet agrees with it in the form of the genitalia.

But after all, a comparison of the figures shows that these peculiar forms of metaparamere in *D. vosseleri* and *D. picta* are

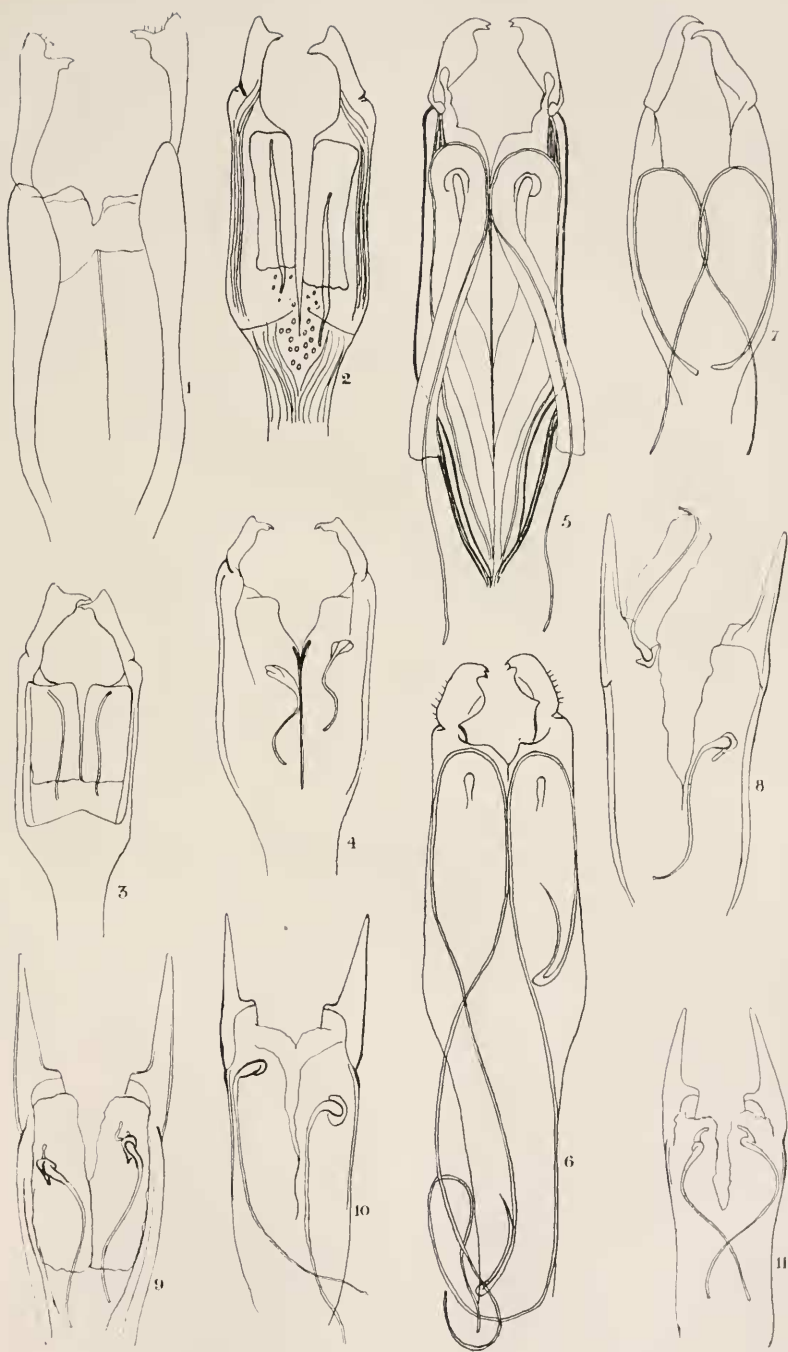
#### EXPLANATION OF PLATE VII.

FIG.

1. *Cranopygia valida* Dohrn.
2. *C. cumingi* Dohrn.
3. *C. modesta* Borm.
4. *C. sauteri* Burr.
5. *Acrania eximia* Dohrn.
6. *A. picta* Guer.

FIG.

7. *Acrania horsfieldi* Kirby.
8. *Echinosoma occidentale* Borm.  
(Entebbe.)
9. Ditto, ditto. (Kamerun.)
10. *E. fuscum* Borm. (Kuako.)
11. Ditto, ditto. (Entebbe.)







merely modifications of the normal Diplatyne type, by blunting and armature of the points.

Other specific characters to be noted in this group are the occasional striated, chitinous structures at the base, and hooks and spines at the tip, of the virga, and the occasional presence of denticulate areas in the præputial sac.

The Neotropical *Cylindrogaster* Stål will probably require to be restored when the material is available.

I can detect no traces of gonapophyses in the female of *D. gladiator*.

In the same species the manubrium is scarcely differentiated from the membranous base of the ninth sternite; it is very short, transverse, and rounded.

### Sub-family 3. KARSCHIELLINÆ.

This is a very well-marked Ethiopian group, with two genera, *Karschiella* Verh. and *Bormansia* Verh. The discrimination of the species is difficult, and I long considered them not to be valid, but it seems that good characters are afforded by the genitalia, and as these are figured by Zacher, presumably from Verhoeff's original material, we now have definite means of discriminating at least most of the species. The genitalia of *B. meridionalis* Burr, and of *B. orientalis* Bor., are still unknown, but I am daily expecting the arrival of some fresh specimens of the former from Rhodesia, which will give the information required.

#### Genus *Karschiella* Verh.

The three known species of *Karschiella* may be distinguished as shown below; for want of clear discrimination I prefer to sink *K. bidentata* Zacher as a synonym of *K. neavei* Burr.

- |   |                              |
|---|------------------------------|
| 1. Segmentum anale ♂ processu nullo instructum, solum utrinque carinatum; parameres denti brevi armati (Pl. V, figs. 20 and 21) . . . . .                 | 1. <i>Neavei</i> Burr.*      |
| 1, 1. Segmentum anale ♂ processu acute utrinque instructum.   |                              |
| 2. Pronotum distincte transversum; processus anales paralleli; parameres dente interno longiori, ad angulum autem inserto (Pl. V. fig. 19) . . . . .      | 2. <i>Büttneri</i> Karsch.   |
| 2, 2. Pronotum haud transversum; processus anales divergentes (?); parameres dente interno ad angulum rectum inserto, breviori (Pl. V. fig. 18) . . . . . | 3. <i>Camerunensis</i> Verh. |

\* This species is somewhat larger than the other two; the form of the meta-parameres is quite distinctive.

Genus *Bormansia* Verh.

This genus agrees generally with the preceding, which it replaces in Eastern Africa, but it may be distinguished at once by the entire absence of any rudiments of elytra, and the consequently differently constructed pronotum. Of the four known species, *B. orientalis* Bor. and *B. meridionalis* Burr have not yet been examined in this respect, but the two original species of Verhoeff's can be separated, according to the figures give by Zacher, presumably from Verhoeff's originals; the features given by Verhoeff are certainly scarcely sufficient to justify the separation of these two species.

I have not had the opportunity of examining the genitalia of this genus, but Zacher figures and describes it; the virga appears to be complex.

## TABLE OF SPECIES.

- |   |                                |
|---|--------------------------------|
| 1. Forceps ♂ dente valido armatus.  |                                |
| 2. Pronotum fere quadratum (Pl. V, fig. 22)                                       | 1. <i>Africana</i> Verh.       |
| 2, 2. Pronotum latius quam longius, antice angustatum, subacutum (Pl. V, fig. 23) | 2. <i>Impressicollis</i> Verh. |
| 1, 1. Forceps ♂ inermis   | 3. <i>Meridionalis</i> Burr.   |

## Sub-family 4. PYGIDICRANINÆ.

The old comprehensive genus *Pygidierana* of Serville was first sub-divided in 1908, when I erected four new genera, based chiefly upon the form of the pronotum and of the ninth sternite of the male.

In 1911 a further arrangement was proposed by Zacher, based on certain new characters, the chief being the genital armature. This arrangement was admittedly provisional only, as the author had but meagre material at his disposal.

I have been able to examine, and here figure, the genitalia of a number of additional species, which involves a recasting of both existing systems. I find a considerable diversity of form in the male genitalia, which I am prepared to admit offer better generic characters than the width of the pronotum and ninth male sternite, formerly employed by me, and it is necessary to modify the arrangement and definition of the genera, which fall into fairly well-defined geographical groups, much better indeed than they did under the old arrangement. As a specific instance let us take the genus *Pyge* Burr, the type of which is the Oriental *P. modesta* Borm. The characteristic of this genus as defined originally is the

strong abbreviation of the organs of flight. Now, species in South America on one hand, and in the Malay Archipelago on the other, being simultaneously subject to the tendency towards brachypterism which is so general in the Dermaptera, will show the abbreviation in the same way, so that two species, inhabiting widely separated districts, may both show similar brachypterism by convergence, and therefore fall into the genus *Pyge* as originally defined, without being actually closely allied, and I think that the genital armature will more truly show the phylogenetic relationship, and be less subject to convergence, than the development or abbreviation of the organs of flight. I feel therefore justified in re-arranging the genera about their respective types according to the form of the male reproductive organs. We at once see that the genera, as thus re-arranged, fall into more natural geographical groups.

There are two types of virga. One is very long, many times as long as the metaparameres, and coiled; this is seen in *Aerania*. The other type is short, and may be strongly bent, with or without a chitinous reflexed lobe at the base, or straight and simple.

The metaparameres are of four types—broad, dilated, as in *Pygidicrana*; lanceolate, with lanceolate tooth, as in *Dicrana* and *Acnodes*; apically knobbed, with a broad tooth, as in *Kalocrania*, *Cranopygia*, and *Tagalina*; or knobless, and curved into a sharp hook, as in *Aerania*.

I have wished to avoid creating new genera until more extensive material is available, and have confined myself to erecting one for *Kalocrania picta* and its allies, with a very distinctive form of metaparameres and virga; but probably new genera will be required for *Aerania horsfieldi*, *Kalocrania dæmeli*, and *Acnodes americano*.

In *Aerania picta* Guér. the manubrium is parallel-sided, rounded at the tip, a little broader than long.

#### TABLE OF GENERA.

- |  |                             |
|--|-----------------------------|
| 1. Metaparameres nec dentati nec mucronati, sed dilatati; (genus americanum) . . . . .                   | 1. <i>Pygidicrana</i> Serv. |
| 1, 1. Metaparameres vel mucronati vel dentati; (genera mundi antiqui, <i>Acnodes americano</i> excepto). |                             |
| 2. Metaparameres lanceolati, denti forti et acuto, angusto; genera ethiopica.                            |                             |
| 3. Caput pronoto angustius; segmentum penultimum ventrale ♂ angustum . . . . .                           | 2. <i>Picrania</i> Burr.    |
| 3, 3. Caput tam latum quam pronotum; segmentum penultimum ventrale ♂ latum.                              |                             |
| 4. Elytra et alæ perfecte explicata . . . . .  | 3. <i>Dicrana</i> Burr.     |
| 4, 4. Corpus omnino apterum . . . . .  | 4. <i>Acnodes</i> Burr.     |

## TABLE OF GENERA—continued.

- 2, 2. Metaparameres haud lanceolati, mucronati vel lobati; genera orientalia et australica.
3. Tarsorum segmentum primum ac secundum valde dilatata; metaparameres lobati; genus papuum . . . 5. *Tagalina* Dohrn.
- 3, 3. Tarsorum segmenta haud lobata.
4. Metaparameres apice lobati, obtuse dentati.
5. Virga basi mucronata, circa triplo longior quam metaparameres; (segmentum penultimum ventrale ♂ latum; elytra perfecta; genus orientale) . . . 6. *Kalocrania* Zach.
- 5, 5. Virgasubrecta, simplex, quam metaparameres sesquilongior . . . 7. *Cranopygia* Burr.
- 4, 4. Metaparameres haud lobati, sed mucronati; virga longissima, quam metaparameres 6-18 longiores . . . 8. *Acrania* g.n.

Genus *Pygidierana* Serv.

This genus is now restricted to the American forms. Zacher figures the genital armature in *P. V-nigrum* Serv., the type of the genus, and in *P. fiebrigi* Burr, which are the only two species so far examined in this respect; possibly some of the other species, which are at present scarcely known, will require new genera. I have shown the outlines of the metaparameres of the above-mentioned species, from Zacher, for purpose of comparison (Pl. V. figs. 24 and 25).

Genus *Picrania* Burr.

This genus, with the following two, makes a natural group, confined to the Ethiopian region, with a well-marked type of genital armature. The long, narrow metaparameres, with lanceolate tooth, are characteristic of *Picrania*, *Dierana*, and *Acnodes*; they are only known in African species, and all known African species have that type of armature.

*Picrania* itself is only distinguished from *Dierana* by the narrow head, which is no broader than the pronotum. There is a single undoubted species, *P. liturata* Stål, the type of the genus, which unfortunately is only known from Stål's original nomotype in the Stockholm Museum. Professor Sjöstedt has been good enough to send me an excellent water-colour of this specimen,



which is a female; and therefore we must await the discovery of the male before the truly typical genitalia of the genus can be described, but there is every reason to believe that they will be found to closely resemble those of the other African species.

The creature described by Zacher under the name of *P. liturata* is certainly not that species; his original specimen from Bulongwa is in the Berlin Museum (Pl. VI. fig. 7). The apex of the abdomen has been lost, which does not matter so very much, since Zacher has described and figured the metaparameres, which are uncommonly like those of *D. wigginsii* Burr; it seems that Zacher was depending on Verhoeff's determination. There is a label attached to the specimen in Verhoeff's writing, "*Pyg. phœnix aberrans*," which is rather confusing, as the *P. phœnix* of Zacher is a West African species, from the Kamerun, which is unknown to me, and insufficiently described.

Accordingly, *Picrania* is now restricted to the type species, *P. liturata* Stål, of which the male is unknown; *P. angustata* Dohrn must be removed to *Kalocrania* or perhaps to *Cranopygia*; the so-called *P. liturata* of Zacher is uncommonly like *D. wigginsii* Burr, but a size smaller; and *P. phœnix* of Zacher remains a doubtful species until his type has been identified, figured, and redescribed.

#### Genus *Dicrana* Burr.

The type of *Dicrana* is *D. frontalis* Kirby, the genitalia of which have not yet been examined, but as all Ethiopian Pygidi-cranids so far studied have similar genitalia we may expect *D. frontalis* to be of the same form until it is proved otherwise, and *Dicrana* is restricted to the Ethiopian forms having long lanceolate metaparameres, with a long, narrow apically bifid, internal tooth (Pl. VI. figs. 1 to 6). Zacher figures *D. caffra* Dohrn and *D. elongata* Zacher, which I do not yet know. I add *D. bettoni* Kirby, *D. biafra* Borm, and *D. wigginsii* Burr. I also include *Picrania phœnix* Zacher as having parameres of the same type, since Zacher gives us reason for including it in *Picrania*, as defined by me.

It should be noted that in his table of genera Zacher refers to a single tooth, but in his figures of *D. caffra* and *D. elongata* he distinctly shows the inner tooth of the metaparameres to be bifid.

#### *Species definitely ranged here—*

<i>D. bettoni</i> Kirby.	<i>D. caffra</i> Dohrn.
<i>D. wigginsii</i> Burr.	<i>D. phœnix</i> Zacher.
<i>D. elongata</i> Zacher.	<i>D. biafra</i> Borm.

#### *Species probably to be ranged here—*

<i>D. separata</i> Burr.	<i>D. frontalis</i> Kirby.
<i>D. livida</i> Bor.	

It will be noted that the genitalia of *D. caffra*, as figured by Zacher, are practically identical with those of *D. bettoni* Kirby figured here. This may mean, either that the latter is merely the macrolabious form of *D. caffra*, or that Zacher's identification is incorrect.

My figure of *D. wigginsii* Burr shows a metaparamere so like that figured under the name of *Picrania liturata* by Zacher that I expect here, too, there is identity (Pl. VI. fig. 1).

## TABLE OF SPECIES.

- |  |                               |
|--|-------------------------------|
| 1. Elytra abbreviata, alæ abortivæ . . .                         | 1. <i>D. wigginsii</i> Burr.  |
| 1, 1. Elytra et alæ perfecta.                                    |                               |
| 2. Segmentum penultimum ventrale ♂ margine postico medio exciso. |                               |
| 3. Forcipsis brachia ♂ contigua, recta.                          |                               |
| 4. Elytria unicoloria . . .                                      | 2. <i>D. biafra</i> Burr.     |
| 4, 4. Elytra maculata. . .                                       | 3. <i>D. grotei</i> Burr.     |
| 3, 3. Forcipsis brachia ♂ arcuata . . .                          | 4. <i>D. elongata</i> Zacher. |
| 2, 2. Segmentum penultimum ventrale ♂ margine postico integro.   |                               |
| 3. Forcipsis brachia ♂ brevia, fortiter arcuata.                 |                               |
| 4. Forcipsis brachia ♂ ante apicem dilatata . . .                | 5. <i>D. bettoni</i> Kirby.   |
| 4, 4. Forcipsis brachia ♂ ante apicem fortiter dentata . . .     | 6. <i>D. caffra</i> Dohrn.    |
| 3, 3. Forcipsis brachia ♂ longiora, leviter arcuata.             |                               |
| 4. Elytria vittis angustis rufescentibus 2 ornata . . .          | 7. <i>D. frontalis</i> Kirby. |
| 4, 4. Elytra macula pallida ornata ♂ ignotus . . .               | 8. <i>D. separata</i> Burr.   |
|  | 9. <i>D. livida</i> Bor.      |

Genus *Acnodes* Burr.

The type of this genus, *A. wellmanni* Burr, from Portuguese West Africa, has typically Ethiopian parameres, and the total apterousness is the only character which separates it from *Dicrana* Burr (Pl. VII. fig. 8).

The apterous American species, *A. americana* Burr, which has so strong a superficial resemblance to *A. wellmanni*, will probably require to be removed to another, and perhaps new, genus when the genitalia are examined.

Genus *Tagalina* Dohrn.

This old genus remains characterized by the peculiar form of the tarsi; the male reproductive organs are of the same general type as those of *Cranopygia* (Pl. VI. fig. 9).

Genus *Kalocrania* Zacher.

Zacher formed this genus for the Oriental species, fixing *marmoricrura* as the type, figuring that species, and *similis* Zacher, which I am inclined to think may be identical with *siamensis* Dohrn.

The metaparameres are rather broad, with a blunt knob at the apex, and a blunt tooth on the inner margin near the apex. In *Kalocrania dæmeli* this knob is nearly obsolete, showing a transition towards the mucronate metaparameres of *Acrania*.

Zacher describes the virga of *K. marmoricrura* as straight, yet he figures it as doubled at the base of the præputial sac, there being no marked division between it and the ejaculatory duct (Pl. VI. figs. 10 and 11). Including as virga the whole tube from the hook near the base of the proparameres, the virga is about four times as long as the metaparameres in both *marmoricrura* and *similis*. I bring in here *P. piepersi* Burr from *Pyge*, as now I refuse generic value to mere reduction of elytra (Pl. VI. fig. 12).

Genus *Cranopygia* Burr.

This genus may have to be sunk in *Kalocrania*, or rather, if they eventually coincide, it is *Kalocrania* which will be sunk in the prior *Cranopygia*, but the definition of the latter must be modified; the metaparameres are of very similar design to those of *Kalocrania*, but the virga is shorter, and straight (Pl. VI. figs. 13 and 14). Until the larger number of species have been examined, it is worth while retaining this genus, but enlarging it, so as to include *kallipyga* Dohrn, and *dæmeli* Dohrn, which were formerly wrongly included in *Dicrana*, before the restriction of that genus to Ethiopian species. *K. valida* Dohrn will also come here from *Kalocrania*; it is close to *C. cumingi* (Pl. VII. fig. 1).

The narrow ninth sternite of the type species, *C. cumingi*, can no longer be regarded as the defining character of the genus, since *C. kallipyga* and *C. dæmeli* are included here, and as also bachypoterism is rejected as a good character, it logically follows that *Pyge* Burr must fall; the genitalia of its type, *P. modesta* Borm., and of *P. sauteri* Burr are of the same general type (Pl. VII. figs. 3 and 4).

Genus *Acrania* g.n.

Metaparameres intus inflati, extus rotundati, apice recurvi, mucronati, sæpius bifidi; virga simplex, longissima.

Metaparameres inflated on inner margin, rounded externally, the tips hooked, often bifid; virga simple, very long.

Type of the genus, *Acrania picta* Guér.

In external structure agrees generally with *Kalocrania*; but the metaparameres are neither knobbed nor toothed, but recurved into a sharp hook, which is bifid at the apex in *A. picta* Guér and *A. eximia* Dohrn, but simple in *A. horsfieldi* Kirby.

A further characteristic of the genus is the great length of the virga; from the extreme base, at the roots of the proparameres, it extends as a simple tube up the entire length of the proparameres, right through the præputial sac, extending, even in repose, far beyond (Pl. VII. figs. 5 to 7).

In *A. picta* the virga is armed at the base with a long, narrow, curved, acute, chitin plate, and the whole virga is nearly eighteen times as long as the short metaparameres, but is not convoluted.

In *A. eximia* the virga is similar, but I can detect no basal armature; the metaparameres are a little longer and the virga is a little shorter, so that the latter is about six times as long as the former.

*A. horsfieldi* is rather different, and will perhaps require a distinct genus; its narrow ninth sternite of the male and general slender build distinguish it from the sturdy *A. picta* and *A. eximia*, and the metaparameres are longer and the hook is entire, not excised at the apex. The virga is about six times as long as the metaparameres, with a slight basal enlargement.

## Sub-family 5. ECHINOSOMATINÆ.

This is a well-characterized sub-family, palæotropical in distribution, corresponding to the allied Neotropical *Pyragrinæ*.

Zacher has called attention to several remarkable features in the genital armature. The metaparameres are long and narrow in the apical portion, and broad and dilated at base, the attenuation

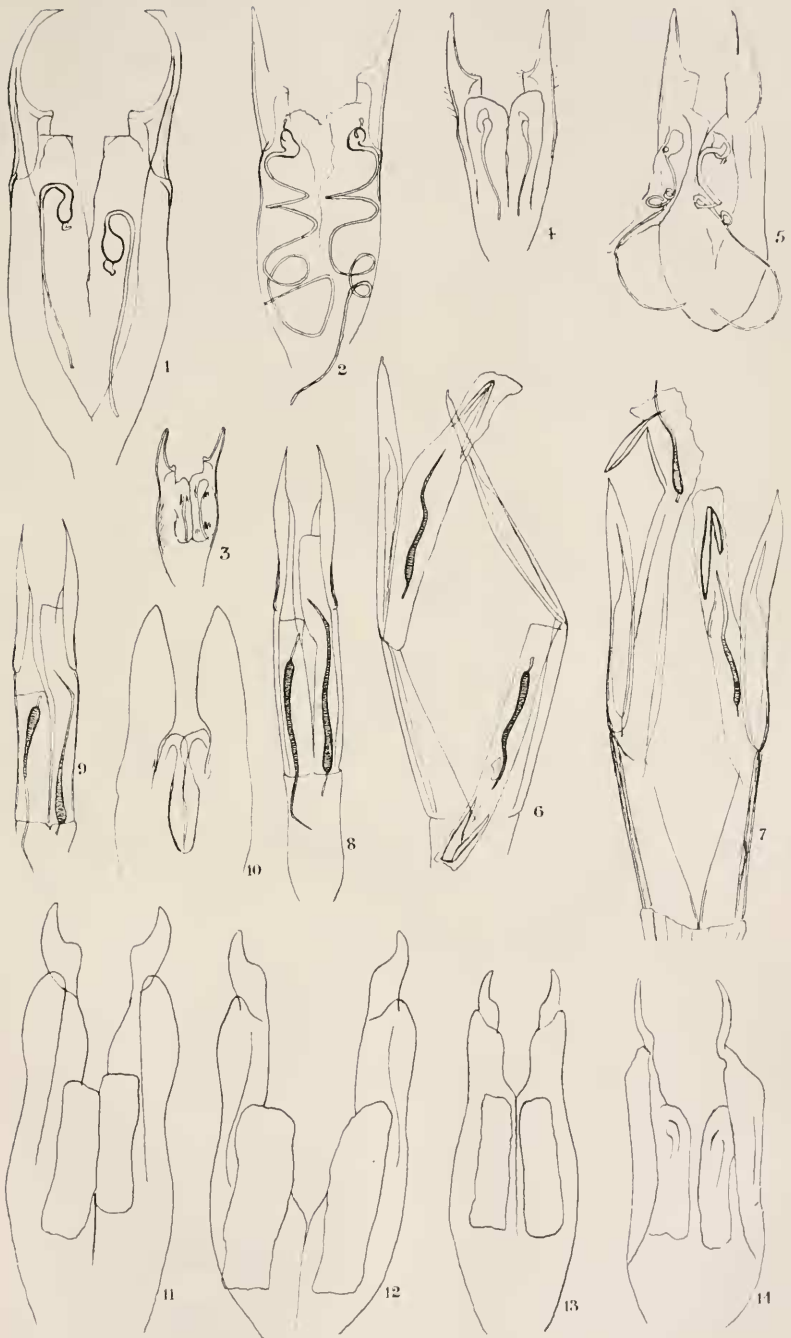
## EXPLANATION OF PLATE VIII.

FIG.

1. *Echinosoma bolivari* Rodz.
2. *E. wahlbergi* Dohrn.
3. *E. parvulum* Dohrn.
4. *E. sumatranum* Dohrn.
5. *E. distant* Burr.
6. *Gonolabidura astruci* Burr.
7. Ditto, ditto.
8. *Allotethella doriæ* Dubr.

FIG.

9. *Allotethella doriæ* Dubr.
10. *Allotethus indicum* Hagenb. (nymph).
11. *Pyragra fuscata* Serv.
12. *P. dohrni* Sauss.
13. *Pyragropsis paraguayensis* Bor.
14. *P. thoracica* Serv.







beginning abruptly near the base. Zacher describes this as a tooth, connected to the proparameres by a fine chitinous membrane, but the membrane is really a rigid but thin chitinous plate, and an essential part of the metaparameres, comparable to the delicate inner membrane so well seen in the *Psolidæ*. The hinge is degenerate, and the junction of the pro- and metaparameres recalls that of the Endermaptera. At the base of the virga is an inflated vesicle not unlike that seen in certain *Pygidicranidæ*, e.g. *Crano-pygia dameli*, and in the *Forficulidæ* among the Endermaptera. The virga is relatively short, not much longer than the metaparameres, in some species, or five or six times as long, and convoluted, in others.

A noteworthy feature is seen in the two pairs of gonapophyses of the female. The pair of the eighth segment is long and slender, but not so very long as in the *Pygidicranidæ*. The pair of the ninth segment is broad and flat; both pairs are strongly pubescent. These will probably afford useful taxonomic characters.

The validity of several of the so-called species is much open to question; for instance, the Indo-Malayan group of *E. sumatranum* Haan, *westermanni* Dohrn, and *horridum* Dohrn, will probably be shown to be one species. The African *Echinosomas* fall into two groups, the small species, as *E. sekalarum* Borm and *E. congolense* Bor., on one hand, and the big forms *E. afrum* Beauv., *E. occidentale* Borm, *E. fuscum* Bor., *E. wahlbergi* Dohrn, *E. distanti* Burr, *E. bolivari* Rodz., and *E. insulanum* Karsch, on the other.

Probably *E. bolivari* and *E. insulanum*, both Madagascan forms, should be united, as also the colour variant from the Seychelles recorded by me as *E. bolivari* var. Of the Continental forms I think *E. distanti* Burr is to be fused with *E. wahlbergi* Dohrn, and *E. fuscum* Bor. with *E. afrum* Beauv., of which *E. occidentale* Borm is a local race, well marked by the peculiar colouring of the elytra.

The Papuan and Australian *E. forbesi* Kirby, and *E. yorkense* Dohrn, seem to be another pair, only differing really in size. *E. parvulum* Dohrn, from Ceylon, is certainly a good species (Pl. VIII. fig. 3).

As to the genitalia, *E. bolivari* is well characterized by the form of the metaparameres, which are narrow, gently arcuate, and truncate at the apex. If Zacher's identification of *E. insulanum* is correct, and I see no reason to question it, more particularly as he had access to Karsch's type in the Berlin Museum, it is practically identical, the slight differences seen in the virga being easily accounted for by differences of point of view and preparation.

*E. wahlbergi* is well characterized by the long convoluted virga, also seen in *E. distanti*, which I feel I must accordingly reduce to the rank of a merely well-developed form of the same species (Pl. VIII. figs. 2 and 5).

Of the large Continental Ethiopian species, I have mounts of *E. fuscum* from Kuako, *E. occidentale* from Entebbe, *E. afrum* from Entebbe and from Spanish Guinea, and *E. occidentale* from the Kamerun (Pl. VII. figs. 8 to 11). I can find no specific distinction in their genital armature, and consequently feel obliged to regard them as mere colour variants of the original species, *E. afrum* of Palisot de Beauvois.

These three principal Ethiopian species may accordingly be tabulated as follows :—

- |       |  |                            |
|-------|--|----------------------------|
| 1.    | Metaparameres arcuate, and apically truncate . | <i>E. bolivari</i> Rodz.   |
| 1, 1. | Metaparameres straight and angustate.          |                            |
| 2.    | Virga moderately long . . . . .                | <i>E. afrum</i> Beauv.     |
| 2, 2. | Virga very long and convoluted . . . . .       | <i>E. wahlbergi</i> Dohrn. |

The genitalia of the Indo-Malayan *E. sumatranum* agree very closely with those of *E. afrum*, and those of the small Cingalese *E. parvulum* are almost the same (Pl. VIII. fig. 3).

In the latter the virga is short and nearly straight ; the hinge is only visible as a thickening in the chitin.

#### Sub-family 6. ALLOSTETHINÆ.

This group has been discussed in great detail by Zacher. The metaparameres are narrow, long, and lanceolate ; the virga is rather broad basally, attenuate gradually. It is not very clearly figured by Zacher. We meet here for the first time with a fine spiral network, called by Zacher "Spiralversteifung," which is so familiar a feature in the later groups ; it remains to be seen whether its function is, as Zacher's name suggests, a protective apparatus to give rigidity to a delicate structure, or whether it is a muscular contrivance for the contraction of the virga to effect or assist ejaculation. It is only seen where the virga is inflated to form a vesicle, or the beginning of a vesicle, as in this sub-family ; in appearance it resembles the armature of the tracheæ.

Zacher states in a general way that the virga is relatively short, only about one-third of the length of the penis ; this is true in *Allostethus* and *Gonolabidura*, but in *Allostethella doriae* the virga is much longer (Pl. VIII. figs. 8 and 9). As the præputial sac is an elastic organ, it is better to compare the length of the virga with the rigid metaparameres. From Zacher's figures the virga appears to be a little more than half as long as the metaparameres in *A. indicum* and less than half as long in *Gonolabidura volzi*, and a trifle longer in *Allostethella malayana* Zacher. In *Gonolabidura astruci* Burr it is about half as long as, and in *Allostethella*

*doriæ* Dubr. a little longer than, the metaparameres (Pl. VIII. figs. 6 and 7).

I maintain firmly the conviction that I have expressed elsewhere, that *Gonolabidura volzi* Zacher is identical with *G. piligera* Borm., and that *Allosthetella* (which should be written *Allostethella*) *malayana* Zacher and *A. nitens* Zacher are but familiar colour-variants of *A. doriæ* Dubr.

*Gonolabidura astruci* Burr, the first Allostethid recorded from India, has the genitalia typical of the group, but noteworthy is the narrow double chitin-plate in the apex of the præputial sac.

I cannot understand why Zacher brings the names *Gonolabis* and *Esphalmenus* into discussion under this sub-family. He implies that I have suggested at some time a relationship between those genera and the *Allostethidæ*, of which I am entirely innocent.

The female has two pairs of gonapophyses, the first pair broad and rounded, delicate and membranous, the second pair narrower. I cannot find any mention of them either in Verhoeff nor in Zacher.

In *A. indicum*, the manubrium is rather narrow, distinctly longer than broad, almost parallel-sided, and rounded at the tip (Pl. VIII. fig. 10).

#### Sub-Family 7. PYRAGRINÆ.

This group was practically unknown to Zacher, so that he confines himself to a statement as to the reduction of the female gonapophyses.

Unfortunately I have had no fresh or spirit material to examine, and so have been obliged to content myself with the preparation of very old and dry specimens, in none of which is the virga discernible, but the form of the parameres is quite distinct. The metaparameres are much shorter than the pro-parameres, and are socketed in with a distinct hinge. The metaparameres are convex on the outer margin, narrowed at the tips, concave on the inner margin in the apical half, with a blunt, rounded projection in the basal half, which corresponds to the inner basal tooth in the *Echinosomatinae*, which are undoubtedly related to the *Pyragrinae*.

I can detect no difference between the genitalia of *Pyragra fuscata* Serv. and *P. dohrni* Scudd (Pl. VIII. figs. 11 and 12).

Of the allied genus *Pyragropsis* Bor. (= *Propyragra* Burr), in *P. paraguayensis* Bor., the parameres are exactly the same in form, only a little smaller (Pl. VIII. fig. 13).

But in *P. thoracica* Serv. there is a well-marked difference; the

metaparameres are very much narrower, and almost perfectly crescent-shaped, the internal basal dilation being practically obsolete (Pl. VIII. fig. 14).

It is unfortunate that we have not got any record of the genitalia of *Pyragropsis tristani* Bor., type of that genus, since it may turn out that we may yet keep *Pyragropsis* and *Propyragra* distinct, one for the *Pyragra* and *P. paraguayensis* type of metaparameres, the other for the *P. thoracica* type.

It will be interesting, too, to see the form of the virga in this group.

In *Pyragra fuscata* Serv., *Pyragropsis thoracica* Serv., and *P. paraguayensis* Bor., the manubrium is short and transverse, well rounded, almost semi-circular.

#### Sub-family 8. BLANDICINÆ.

This imperfectly known sub-family is provisionally erected for the unique specimen in the Vienna Hofmuseum, which I have described under the name *Blandex solvendus*; it is simply labelled "South Africa." The relationship of this curious creature is still uncertain; there is something Pygidicranine in its appearance, especially in the style of coloration. The antennæ recall those of *Anatælia*, but the keels of the femora are obsolete, or almost, as also those of the elytra; the structure of the sternum agrees with that of *Anatælia* and *Challia*. I can detect no combs on the mesosternum, so it is a truly apterous species, although the elytra are free.

The genitalia are curious, and do not resemble at all closely those of any other species; the metaparameres are short and broad, and bilobed, like a finger and thumb; the straight and moderately long virga is quite simple, and not unlike that of the same organ in some *Pygidicraninæ*; but the fine dentition of the præputial sac is an unusual feature in the *Pygidicraninæ*. It is highly desirable that more material be found, so that the opisthomeres may be examined, and the presence or absence of gonapophyses in the female be determined (Pl. IX. fig. 1).

#### FAMILY LABIDURIDÆ.

My limitation of this group differs but little from that of Zacher. I propose to remove the *Allostethinæ* to the *Pygidicranidæ*, as we have seen, and to include the *Apachyidæ*, suppressing the sub-order *Paradermaptera* of Verhoeff. As Zacher has shown, the genitalia and general structure are suggestive of Labidurine affinities; the two most striking features, the extreme flattening of the body, and the fusion of the opisthomeres into a squamopy-

gidium, are seen also in the *Platylabiinæ* and the genus *Gonolabina* respectively.

TABLE OF SUB-FAMILIES.\*

1. Body not strongly flattened.
  2. Prosternum narrowed posteriorly; metaparameres short and broad; virga dilated; manubrium triangular; squamopygidium as in *Gonolabina*; virga inflated, and with spiral structure . . . . . 1. ESPHALMENINÆ.
  - 2, 2. Prosternum not narrowed posteriorly; (squamopygidium never formed).
    3. Manubrium very long, narrow at base, dilated at apex; virga, when present, simple; metaparameres lanceolate or dilated . . . . . 2. PSALINÆ.
    - 3, 3. Manubrium short, never more than twice as long as broad, and never dilated at the apex.
      4. Antennæ with 25-35 segments; prosternum constricted posteriorly; meso- and metasterna as broad as long; virga serpentine, with vesicle and spiral structure; manubrium rectangular; pygidium quite six times as long as metapygidium . . . . . 3. LABIDURINÆ.
      - 4, 4. Antennæ with 10-15 segments; prosternum nearly parallel-sided; meso- and metasterna transverse; pygidium only about twice as long as metapygidium.
        5. Postfrontal and median sutures of head very distinct, præfrontal absent; virga with vesicle and spiral armature . . . . . 4. PARISOLABINÆ.
        - 5, 5. Postfrontal and median sutures obsolete, præfrontal distinct; virga not inflated, and no spiral armature . . . . . 5. BRACHYLABINÆ.
  - 1, 1. Body strongly flattened.
    2. No squamopygidium formed . . . . . 6. PLATYLABIINÆ.
    - 2, 2. Squamopygidium in both sexes . . . . . 7. APACHYINÆ.

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\* The *Landicinæ* were included after the above table was drafted; circumstances have prevented the modification necessary to admit this new sub-family, but it is so well characterized that it can be at once discriminated.